BOTANY AT THE ANNIVERSARY MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY ERWIN F. SMITH.

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SECTION G was organized Monday noon, August 22d; Dr. W. G. Farlow, President. Regular sessions were held Tuesday morning, afternoon and evening and Thursday morning and afternoon; Wednesday and Friday being given up to excursions. Fifty-six papers were listed and forty-seven were read.

Thursday morning Mr. A. B. Seymour, on behalf of the Committee on Bibliography, appointed at the Madison meeting, made a report of progress, which dealt principally with the question of subject arrangement. On motion of the Secretary, the Section directed the Committee to include Bacteriology in the list of subjects covered by this Bibliography.

The large number of papers and the limited time prevented full discussion in many instances. Numerous excursions also interfered more or less with the regular work of the Section, but these afforded much pleasure to all who could take part in them and were not least of the Boston attractions.

Visiting botanists were very hospitably entertained, and altogether the Boston meeting was exceedingly pleasant and profitable.

The following abstracts have been prepared with much care, in most cases from the authors' MSS. or abstracts, and it is to be hoped that they are reasonably free from errors, and ample enough to give the many who could not be present a clear idea of what was said and done.

The Carposporic Type of Reproduction of the Rhodophyceæ. BRADLEY M. DAVIS.

RECENT investigations in this field of research show a tendency to depart from the teachings of Fr. Schmitz. These were characterized by the assumption of a second act of fertilization in the Rhodophyceæ exhibited in the phenomenon of fusion between auxilliary cells and filaments or processes put out by the carpogonium. The speaker described studies of his own upon *Champia*, showing their divergence from the doctrines of Schmitz, and followed with a more general discussion of the peculiar conditions found here, expressing himself as in sympathy, in the main, with the recently published views of Oltmann. All evidence at present points to the probability that the cell-fusion phenomenon following the development of the carpogonium is associated with and the result of nutritive functions. The entire group of Rhodophyceæ is so peculiar that any attempt to establish a general type of reproduction is fraught with great danger.

The Comparative Morphology of the Pistils of the Ranunculaceæ, Alismaceæ and Rosaceæ. ERNST A. BESSEY.

THE uni-ovulate pistil in the Ranunculaceæ originates as an open leaf in whose axil grows a mass of cells from the receptacle forming one side of the cavity of the pistil whose other sides are formed by the laminæ and by the curved distal portion

of the carpel. Into this cavity grows a median ovule from the axillary mass of receptacular cells. *Sagittaria* and *Alisma* have practically the same structure, except that the ovule in the latter grows directly from the receptacle instead of from an outgrowth of it. *Potentilla* and *Fragaria* show a course of development very similar to the foregoing; an open pistil is formed, but the ovule, instead of growing from the receptacle, grows from the thickened edge of one or the other of the laminæ. This similarity of development apparently supports that system of classification of the Angiosperms, in which there are three diverging lines of development having a common origin, one with the Alismaceæ first, being the Monocotyledonæ, the two others forming the Dicotyledoneæ, one with the Ranunculaceæ lowest being the Thalamifloræ and passing up to the Heteromeræ and to the Bicarpellatæ, the other with the Rosaceæ lowest being the Calycifloræ and passing up to the Inferæ.

Origin and Homologies of Blepharoplasts. HERBERT J. WEBBER.

THE new features emphasized by the author in this paper were as follows: The blepharoplasts in *Zamia* arise *de novo* in the cytoplasm of the generative cell, as previously described by him in the case of *Ginkgo*. They appear first as minute bodies with a few kinoplasmic filaments centered upon them. At this time no differentiation into outer membrane and interior contents can be distinguished. As they increase in size the radiating filaments become more abundant and an outer membrane becomes plainly differentiated.

In the bursting of the blepharoplast to form the spiral cilia-bearing band of the spermatozoid the first change, other than increase in size, is distinguishable in an early prophase of the division of the generative cell. The vacuolated contents of the blepharoplast begin gradually to contract away from the outer membrane, which meanwhile increases in size. When the division has reached the metaphase the contents have become contracted to a very small body, and the outer membrane, which has become considerably extended, is shown in section to be broken into numerous segments or plates. The disappearance of the central nucleolus-like contents seems to be correlated in some way with the growth of the outer membrane. Appearances suggest that it is utilized as food matter in the growth of the membrane. In the next stage which the writer has studied, an early telephase, the blepharoplast is represented by numerous round or oblong granules grouped in a somewhat irregular spherical mass, which stain the same as the outer membrane of the blepharoplast in the preceding stage. It would seem that the outer membrane of the blepharoplast breaks up into numerous segments which assume a roundish form and become crowded together into a spherical mass through the action of the cytoplasm.

In a late telephase a slender membrane can be discovered protruding from this mass of granules and bending toward the nucleus. As the development advances, the membrane grows in length and width, and the granules meanwhile gradually arrange themselves along one side and decrease in number. During the further development of the membrane the granules gradually disappear and apparently either unite directly to form the membrane or are absorbed through its growth. Some preparations give evidence that the granules fuse together to form the membrane, and the writer is inclined to this interpretation of the phenomena presented.

The further stages in the elongation of the membrane into the cilia-bearing band of the antherozoid have been described by the writer in another place.

The Blepharoplast in the Spermatogenesis of Marsilia. DR. W. R. SHAW.

IN the development of the male prothallia of *Marsilia vestita* no blepharoplasts or other centrosome-like bodies are found in any of the six cell divisions or resting stages preceding the formation of the primordial spermatogenous cell, 'central cell,' of each of the two antheridia; nor are any such bodies found in that cell or during its division. The first appearance of centrosome-like bodies is in the spindle poles during the telephase of the second division of the spermatogenous tissue. After this division is complete, *i. e.*, in the 'grandmother cells' of the spermatids, each of these bodies grows into a pair of *blepharoplastoids* which increase in size. They remain together and move into the other region of the cytoplasm, and disappear during the following cell division. During the anaphase or telephase of this division there are formed, at the poles of the spindle, new bodies. After the division, *i. e.*, in the 'mother cells' of the spermatids, each of these bodies develops into a pair of *blepharoplasts*. The blepharoplasts separate, at the same time increasing in size, and move to opposite poles of the cell, where they remain throughout the last division leading to the formation of the spermatids. The further development closely resembles that of the blepharoplasts in the spermatozoids of the cycads.

Observations on the Relative Moisture Content of Fruit Trees in Winter and in Summer. PROFESSOR C. S. CRANDALL.

FROM samples of trunks and branches of apple trees taken January 15th and 16th and August 3d, and thoroughly air-dried, with careful weighing before and after, the author concludes that, as grown under Colorado conditions at least, there is hardly an appreciable difference between the summer and winter moisture.

In the discussion which followed, Professor D. T. MacDougal stated that the water content in the trees in August was practically the winter content, the separative layer in the leaves having probably already begun to form, and that for the determination of the *summer moisture* samples should have been taken sixty to seventy days earlier.

Some Observations bearing upon the Symbiotic Mycoplasm Theory of Grain Rust. PROFESSOR H. L. BOLLEY.

MANY facts and arguments go to show that Erickson's hypothesis has not been established, and is not necessary to account for the first appearances of grain rust. The author finds that uredo and æcidiospores (*Aec. berberidis*, *U. rubigo-vera* and *U. graminis*) germinate readily when placed under favorable conditions; that, when other conditions are the same, shaded, spindling plants are as much subject to infection as those grown in the sunshine, and, finally, that when oats and wheat were grown in rust-proof cages there were no infections whatever, although close outside and for miles around every plant bore numerous pustules.

Some Unique Examples of Dispersion of Seeds and Fruits. PROFESSOR W. J. BEAL.

A POPULAR account, illustrated by specimens. To be printed in full in *The American Naturalist.*

Starch Distribution as affected by fungi. DR. BYRON D. HALSTED.

THE leaves to be studied are placed in 50 per cent. alcohol to remove the chlorophyll, and are then passed into a weak solution of iodine. In a few hours, if the leaf is thin, the starch responds to the iodine test and is located by the blue color it assumes. Tested in this way the parts of plants which are attacked by fungi, *e. g.*, leaf spots due to Peronospora, Cystopus, Synchytrium and Puccinia, and galls due to Cystopus, Gymnosporangium, Plasmodiophora and

Rhizobium show a marked accumulation of starch. The starch is either in the discolored spot or immediately around it. This distribution is very striking in the leaves of Podophyllum attacked by *Puccinia podophylli*, starch being abundant in the well-defined areas, while none was met with beyond the small veins that served as boundaries to the infested portions. The galls of peach roots, the cause of which is still unknown, are gorged with starch. Turnips affected by club root carry a large amount of starch, while the healthy tissue is comparatively free from it. In like manner, the root tubercles of the Leguminosæ contain much starch, while the roots which bear them are comparatively free from it.

The Effect of an Atmosphere of Ether upon Seeds and Spores. DR. C. O. TOWNSEND.

IN order to determine the effect of ether upon the germination of seeds and spores a series of air-tight damp-chambers holding one litre were prepared. After soaking the seeds for twenty-four hours in pure water they were transferred to the damp-chambers which contained respectively 1, 2½, 5 and 10 cc. of ether dissolved in 100 cc. of water. One chamber was left free from ether for comparison. It was found that 1 cc. of ether hastened the process of germination slightly, but the subsequent growth of the seedlings was somewhat retarded by the action of the ether. In the chambers containing 2½ and 5 cc. of ether the process of germination was retarded. The amount of retardation varied from a few hours to several days, depending upon the strength of the ether atmosphere and upon the kind of seed used. An atmosphere containing 10 cc. of ether prevented the seeds from germinating. If the seeds were removed from this strong atmosphere of ether at the end of from seven to ten days, and placed under favorable conditions, they germinated as readily as if they had not been placed in the ether atmosphere. On the other hand, if the seeds remained in the strong atmosphere of ether two weeks they seemed to lose their vitality.

The influence of an ether atmosphere upon spores was investigated by placing the spores upon plates of gelatine containing 10 cc. of sugar. These plates were then placed in damp-chambers containing $\frac{1}{10}$, 2½, 5 and 10 cc. of ether, one chamber remaining free from ether for control, the spores in the atmosphere containing $\frac{1}{10}$ cc. of ether germinated a little earlier than did those in the ether-free atmosphere, while those in the stronger atmospheres of ether were retarded in germinating. Not only did the spores continue to live in the atmosphere containing 10 cc. of ether, but they were able to germinate in about ten days without removing from the ether atmosphere. The amount of retardation was found to depend upon the strength of the ether atmosphere and upon the kind of spores.

The Toxic Action of a certain Group of Substances. DR. RODNEY H. TRUE.

ZOOLOGISTS and botanists have long regarded certain salts, of which sodium chloride and potassium nitrate are commonly-used representatives, as being essentially lacking in toxic action and operative only through their osmotic activity. In this study cane sugar was assumed to be a purely osmotic agent, and the concentration in which the majority of a number of filaments of Spirogyra survived, after an exposure of twenty-four hours, was regarded as the measure of the osmotic action which the alga can endure. This boundary concentration was found to lie at 0.75 gram molecules per litre. Assuming the action of the other substances studied, viz.: glycerine, potassium nitrate and sodium chloride, to be likewise purely osmotic, the boundary concentrations were calculated to lie as

follows: glycerine, 0.75 gram molecules per litre; potassium nitrate, 0.45 gram molecules; and sodium chloride, 0.47 gram molecules. The actual boundary concentrations found by the method used for sugar were as follows: glycerine, $\frac{1}{2}$ gram molecules per litre; potassium nitrate, $\frac{1}{16}$ gram molecules; and sodium chloride, $\frac{1}{10}$ gram molecules. The concentrations producing plasmolysis were as follows; glycerine, $\frac{1}{3}$ gram molecules per litre; potassium nitrate, $\frac{1}{4}$ gram molecules; sodium chloride, $\frac{1}{4}$ gram molecules; and sugar, $\frac{1}{3}$ gram molecules. The boundary concentration for glycerine lies at a concentration greater than that of the cell sap, and probably causes death by osmotic action. The boundary concentrations of potassium nitrate and sodium chloride lie much below the point having the same osmotic value as the cell sap, and much below the boundary concentration calculated on the assumption of purely osmotic action. Consequently, potassium nitrate and sodium chloride exert a pronounced toxic influence upon Spirogyra.

Types of Vegetation on the Florida Keys. C. L. POLLARD.

PAPER, partly ecological, partly floristic. Six distinct belts or zones of plant life are recognized. The main part of the paper consisted of an enumeration and discussion of the characteristic species of these belts, as observed during a six weeks' visit in the spring of 1898.

Potato as a Culture Medium with some Notes on a Synthesized Substitute. DR. ERWIN F. SMITH.

THE length of this report makes it seem best to relegate the abstracts of my own papers, which are long and rather technical, to the forthcoming volume of the Proceedings of the Association, where they may be found by those who desire to consult them.

Some Little Used Culture Media, which have proved valuable for Differentiation of Species. DR. ERWIN F. SMITH.

The Temperature and Transpiration of Desert Plants. PROFESSOR D. T. MACDOUGAL.

THE author reported data taken from field notes made in the desert of the Little Colorado River in 1898.

The temperatures of the bodies of succulent plants in this region at midday is often as high as 45° C., the critical point of protoplasm, and 6° to 8° higher than the surrounding air. The enormous transpiring force exerted is met by the high-soil temperature, which in volcanic sand reaches 40° to 42° C. around the absorbing roots. The actual amount of water used by desert plants, when furnished with an unlimited supply, is very small, however. By use of a potometer it was found to be not more than one-tenth as much as from a corresponding mesophyte of temperate latitudes. Desert plants are, therefore, incapable of great transpiratory or absorptive activity.

The Leaf-spot Disease of the Apple, Phyllosticta pirina, and Several Unrelated Forms occurring therewith. PROFESSOR WM. B. ALWOOD.

PAPER records common occurrence and life cycle of *Phyll. pirina* Sacc. and the occurrence therewith of three apparently unrelated forms, viz.: *Sphæropsis malorum*, *Hendersonia mali*, and an undetermined species.

Notes on Some Diseases of Southern Pines. HERMANN VON SCHRENK.

OF the numerous fungous parasites of the southern pines *Trametes pini* is one of the most destructive. It attacks older trees, entering through a knot and causing decay of the heartwood up and down the trunk. The mycelium dissolves portions of the wood fibers, at first changing them to cellulose. After a time the solution stops, and the wood then appears full of holes with a white lining, the holes separated by lamellæ of apparently sound wood. The 'local'

action of the mycelium is characteristic of numerous fungi destroying wood. The wood not destroyed seems to be protected against the attacks of the fungus ferment by some substance which infiltrates into the wood cells. In the wood attacked by the mycelium of *Trametes pini*, a compound allied to the humus compounds was found, giving the wood a brown color. It is possible that this may be one of a class of preventive substances.

Another prevalent disease is due to *Trametes radiciperda*, which enter the trees through the roots. The mycelium passes up the trunk, causing decay similar to that of *Trametes pini*. It was found destroying numerous trees of *Pinus palustris* and *P. echinata*.

A remarkable Increase in Size of Leaves of Kalmia angustifolia apparently due to Reduction of Light. PROFESSOR W. J. BEAL.

ON May 14, 1898, before flowering, some plants with a little soil attached were removed from an open place at Grayling, Michigan, where they are common, and transferred to the State Agricultural College, 130 miles south, where they were planted in muck, kept wet, and screened about 8 feet from the ground with laths and the leaves of trees, which cut off at least one-half of the light during the middle of the day and a larger per cent. morning and evening. On July 28th the three branches here exhibited were cut from the plants and pressed till dry. The largest leaf on each branch (measured when dry) is 37×17, 45×16 and 47×15 millimeters, while the largest evergreen leaf (growth of the previous year) is 22×9, 25×6 and 25×6 millimeters, *i. e.*, a leaf of this year easily has a surface four times that of a leaf of last year. Similar results were obtained with *Kalmia glauca*. No control plants were retained.

Half Shade and Vegetation. DR. BYRON D. HALSTED.

EXPERIMENTS were made in shading various truck crops with frames of lath placed upon supporting stakes. The space between the lath equalled the width of the lath, so that one-half of the direct rays were intercepted. The temperature under the frames (monthly averages of daily observations) was lower than in the full sun, as follows: May, 4°; June, 4.2°; July, 6.5°; August, 7.7°; September, 16.6°. In general the shade retarded germination, noticeably of the first crop of lima beans, but the opposite was true for the second, or mid-summer planting. All root crops, such as turnips, carrots, potatoes, had a larger leaf surface in the shade, but the roots were smaller. Shade improved the salad crops, lettuce, spinach and Swiss chard. The crop most improved of all by shade was celery. With seed, or fruit-producing crops, such as beans, peas, egg-plants, tomatoes, cucumbers, the time of blooming was retarded and the period of fruitfulness materially prolonged. The foliage is of a deeper green in the shade than in the open. In carrots there is a strong tendency to broaden the dissected portions; in short, in the various crop plants there is an attempt to increase the size of the blade of the leaf. The behavior of the plants was also dissimilar. For example, the exposed bean plants in the brightest and warmest days made all sorts of shifts to reduce the exposure, changing the position of the leaflets from morning until evening, while in the shade the leaflets hung out horizontally and were not noticeably heliotropic. The leaves in the shade were usually much thinner than those grown in full exposure. The record of this fact was made by sunprints of the leaves themselves, the shaded ones invariably being less opaque than the ones grown in the sun. Numerous sunprints were shown to establish the fact of the lesser density of the shade-grown leaves. A study of wild plants along the same lines was

made in a wood lot and adjoining clearing. The cinnamon fern (*Osmunda*) was noted in particular to have graceful, drooping leaves in the wooded land, while in the open the fronds were nearly upright. The leaflets of this fern grown in the shade were .098 millimeters in thickness, while in the cleared land the thickness was .258 millimeters. Many other differences as to hairiness, color of stems, etc., were noted.

Influence of Wet Weather upon Parasitic Fungi. DR. BYRON D. HALSTED.

THIS paper records a striking parallelism between excessive rainfall and the abundance of fungi. May of the present year was remarkably wet, and the following June brought an abundance of parasitic fungi, rust of hollyhock, cedar and mandrake; smut of spring lily, wheat and oats; and many other. The peach-leaf curl fungus was common everywhere. The year 1889 was noted for its wet summer and also for the destruction of potatoes by the rot. The year, since then, nearest like 1889 was 1897, when again July was phenomenal for heavy precipitation, it being 10.19 inches in 1889 and 11.42 in 1897. Last season was like that of 1889 in the outbreak of the *Phytophthora* in the potato fields, causing the wholesale rotting of the tubers. The *Phytophthora phaseoli* Thaxter was discovered in 1889 and reappeared destructively last season. The records of the New Jersey Experiment Station show that in both of the years mentioned there was much black rot (*Physalospora Bidwellii* Ell.) of the grapes and rust (*Gymnosporangium macropus* Lk.) in the apple orchards. In 1894 the growing season opened with a wet May and closed with a rainy September. There were long periods of cloudy weather, and often it was hot and showery. It was this year that witnessed the unprecedented outbreak of the fire blight of apple, quince and pear.

In 1896 there was a rainy June and July, and during this period the asparagus rust (*Puccinia asparagi* DC.) made its appearance in the eastern United States to an alarming extent, and last year it was in even greater abundance. There are not sufficient data for safe and substantial generalizations, but heavy rainfalls in spring seem to induce rusts in grains and orchard and garden crops, and the fire blights of fruit trees. Mid-summer precipitations favor the decay of fruits, particularly the stone fruits, and the rotting of potatoes. Rainfall does not express all the meteorological conditions that need to be taken into consideration in this connection.

In the discussion Dr. Smith noted that peach-leaf curl, *Taphrina deformans*, was reported to the United States Department of Agriculture in the spring of 1898 from a great many places throughout the country, causing more complaint than at any time during the previous 12 years.

The Botanic Gardens of Buitenzorg, Java. DAVID G. FAIRCHILD.

THIS was a popular lecture, illustrated by about forty lantern slides. The speaker announced that one of the main objects of the lecture was to interest Americans in the establisment of a stipendium of $1,000 by means of which an American botanist or zoologist could visit the gardens every year and spend from six to eight months in study there. Slides were exhibited showing the remarkable extent of the gardens, their adaptability to the cultivation of any tropical plant, their especially rich collection of palms, Pandanus and ficus trees, their many new and well equipped laboratories, the herbarium and library. Photographs of the native gardeners and collectors, which form such an important part of the gardens, were also exhibited. The attempt was made to give an idea of the wealth of biological, both botanical and zoological, material which was to be found there, and

stress was laid upon the importance of laboratory facilities in the tropics. The beauties and charms of Dr. Treub's mountain garden at Tjibodas were illustrated, and botanists and zoologists were exhorted to make the effort to see this unparalleled hermitage of tropical biology. The remarkable growth of the gardens in recent years, and the attention and stipendia which Dr. Treub has attracted to it, made it seem probable in the speaker's mind that Buitenzorg will be soon the International Biological Institute of the Tropics, as Naples is the International Marine Biological Institute.

Notes on the Strand Flora of Florida. HERBERT J. WEBBER.

THIS was a popular lecture illustrated by fifty lantern slides. The east coast of Florida as far south as Biscayne Key (latitude about 26° 75′) is lined with low sand dunes ranging from ten to thirty feet in height. The coast line is being gradually extended by the deposition of sand, which is probably carried southward from the Cape Hatteras region. In almost every peninsula and island along the coast of this portion of the State numerous ridges or series of ridges several hundred feet apart, evidently lines of old dunes, run parallel with the coast and mark various stages in its recession. The deposition of sand carried by the waves forms shoals or banks 200 to 400 feet from the shore. This gradual piling-up under the action of currents and waves evidently goes on until the bank becomes sufficiently high to protrude from the water at low tide, and then the wind and waves throw it up still higher. Where these banks remain above water for several months certain dune-building plants, such as *Sesuvium portulacastrum*, *Iva imbricata*, *Cakile maritima*, *Panicum amarum*, etc., spring up, and as they grow the wind banks the sand around them, thus forming a low lines of dunes, to which the sand washed up by the waves is being continually added.

The formation of new lines of dunes in front of the old ones, now lining the shore, plainly shows the gradual recession of the coast line. The dunes now lining the coast at Daytona consist of two parallel ridges of equal height, close together (50 to 100 feet apart), and in some places of a third line in various stages of formation. After the dunes reach the usual height vegetation covers their surface, and thereafter the wind has little effect on them, except gradually to increase their width and height.

Uniola paniculata is the main sand-binding grass to be found on the top and seaward side of the first line of dunes. Here it forms almost 75 per cent. of the vegetation, and this zone may, therefore, be properly termed the *Uniola* formation. Species of *Spartina*, *Panicum*, *Ipomœa*, *Yucca*, *Serenoa*, *Croton*, *Euphorbia*, *Opuntia*, etc., are also commonly found mingled with *Uniola*, but only to a small extent. At the base of the main line of dunes a number of plants grow naturally and serve as dune builders. The principal ones of these are *Pancium amarum*, *Ipomœa pes-caprœ*, *Batatas littoralis*, *Iva imbricata*, *Cakile maritima*, etc. These are also found to a greater or less extent on the tops of the main dunes and in salt marshes, but play their most important rôle in dune building. Growing in bunches, as they do, they catch and hold the sand which is continually drifting about at the base of the dune, and in the course of time banks of increasing height are formed about them until a second line of dunes, nearer the water, is formed.

The islands and keys along the mainland from Biscayne Bay to Key West are of coral formation. Here the vegetation, which is mostly tropical, differs totally from that of the sand dunes above described; the 'mangrove formation,' so well

described by Schimper and Karsten, being the most common. Probably the most interesting strand plant of the open beaches in this section is *Agave decipiens*, which is widely distributed along the strand of tropical Florida, being disseminated almost wholly by bulblets produced in place of the flowers. These bulblets are not injured by extended soaking in salt water. They are usually carried here and there by the tide, are thrown up on the beach by the waves, take root, and produce new plants.

The islands along the west coast of Florida are largely of mangrove formation. Shoals are formed by the action of the water, and on these the mangrove finally takes root, and the roots catch and retain sea weeds and other floating matter, thus gradually building up a humus earth around the trees. On the seaward side these trees interrupt the waves, and thus in time a bank of shell is thrown up, and where the forces continue for long periods more or less extended islands are formed. In their simplest form these consist of a low ridge along the seaward shore, composed mainly of fragments of shell thrown up by the waves, and a mangrove swamp on the landward side. In time the interior of the forming island becomes too high for mangrove vegetation, and the latter gradually gives place to the typical hammock vegetation, that is, live oak, palmetto, etc., which in Florida usually covers all soils rich in humus. The typical islands along this section of the coast, therefore, are composed of a central tract of hammock bordered on the seaward side by a belt of sterile shell land from 100 to 600 feet wide and on the landward side by a mangrove swamp.

The most characteristic plants of the mangrove formation are *Rhizophora mangle*, *Avicennia nitida*, *Laguncularia racemosa*, etc. The most characteristic of the shell belt on the seaward side are probably *Forestiera porulosa*, *Myrsine rapanea*, *Coccoloba uvifera*, *Juniperus virginiana*, etc. Here, as on the east coast, *Iva imbricata*, *Cakile maritima*, *Ipomœa pes-caprœ*, etc., grow abundantly on the margin of the water.

Notes on the relative infrequency of Fungi upon the Trans-Missouri Plains and the adjacent foothills of the Rocky Mountains. PROFESSOR C. E. BESSEY. (Read by title.)

Fungus gardening as practiced by the Termites in West Africa and Java. DAVID G. FAIRCHILD and O. F. COOK.

IN the absence of Mr. O. F. Cook the matter relating to Javanese Termites alone was given. Mr. Fairchild called attention to the presence of three species of Termites as yet unidentified which are fungus growers. The nests of these insects are composed of two parts: (1) the earthen-walled galleries, consisting of tunnels in every direction through the earth or even above it, made by cementing together mouthfuls of mud which the workers of these colony-producing insects deposit like brick layers on a wall; and (2) the wooden maché combs which form the gardens of the Termites, which are built up of wood particles that have passed through the bodies of the workers. These combs are miniature labyrinths, the walls of the passages being covered, top, bottom and sides, with a microscopic sward of fungal hyphæ, which give to it the appearance of a neatly-cut lawn. Rising scattered over this lawn are innumerable cabbage-shaped bodies from microscopic beginnings up to sizes as large as that of a pin head. These bright, almost pearly lustrous bodies, which give to the galleries a most fairy-like appearance, are the compound conidiophores of a species of fungus, presumably a hymenomycete, although cultures of the spores of the mature hymenomycete found growing from the combs failed to establish a connection between the mature form and the cabbages, or more properly termed *cauliflowers*, since

they, like the cauliflower, contain organs of propagation.

Photographs showing the nests of three distinct species of Termite possessing three distinct forms of cauliflowers were shown, and attention was called to the fact that these three species of Termite, although building their nests side by side, often in contact with each other, begin immediately a deadly warfare with each other whenever the workers or soldiers, which latter possess large shear-like mandibles, of one nest trespass upon the domains of a neighbor. Unlike the wars of the real ants, in which, as Lubbock has shown, each nest is a unit and its inhabitants war with the inhabitants of any other nest of the same species, the wars of the Termites are race or species affairs. Termites of one species collected in Buitenzorg, Java, and taken to Tjibodas, some 15 or more miles distant, showed the friendliest relations with individuals of the same species collected there, while individuals of different species, though coming from nests actually almost touching each other in the same hill, fought in the arena of an inverted watch glass, invariably, until one or the other was killed, and often mutilated in a most shocking manner. The fights of these Termites offer unrivalled opportunities for a study of the psychology of these lower animals. The fact that these Termites do actually live upon the 'cauliflowers' of the fungi found growing in their nests was proved by repeated examinations of their stomachs, in which the remains of characteristic conidiophores and half-digested conidia were discovered. The extreme sensitiveness of the insects to light prevented direct observations being made as to their method of eating the cauliflowers.

The three forms of conidiophores were remarkably distinct mycologically, and yet the general effect of the cauliflowers made up of these conidiophores grouped together in masses was much the same. Drawings illustrative of these differences were shown.

The Biology of Cheese Ripening. PROFESSOR S. M. BABCOCK and DR. H. L. RUSSELL.

THE most important changes which occur during the ripening of cheese are those which affect the casein, this being gradually transformed, from the firm, elastic and insoluble conditions found in a green cheese, into the plastic and more or less soluble substance peculiar to a well-ripened product. The early explanations of these changes were purely chemical, but since the discoveries of Pasteur and others in the field of fermentation they have been attributed entirely to bacteria and other micro-organisms. Duclaux suggested that the changes in the casein were due to digesting organisms. Later observers have shown that such organisms fail to develop in competition with the lactic acid type of bacteria, which are by far the most prominent species found in normal cheese. This type appears to be unable to digest casein to any considerable extent when grown in sterilized milk, unless their activity is greatly prolonged by neutralizing the acid as it is formed, in which case again the conditions do not conform to those found in normal cheese. Moreover, the ripening changes in cheese progress at a nearly uniform rate for a long time after bacterial development has greatly declined. The authors of this paper were unable to reconcile the many apparent discrepancies of the biological theory of cheese ripening until they attempted to sterilize milk for their experiments by the addition of mild antiseptics, such as ether and chloroform, which could afterwards be removed and thus avoid changes which might be produced by boiling the milk. Such milks, although sterile, passed through changes similar to those that occur in cheese. As the agents used in this case discriminate between organized and unorganized fer-

ments, it is evident that milk contains an unorganized ferment capable of digesting casein. This enzyme is inherent in the milk itself. The authors have given to this ferment the name *galactase*, and they believe it plays an important rôle in the proteolytic changes that occur in the ripening of cheese.

Fermentation without Live Yeast Cells. KATHERINE E. GOLDEN and CARLETON G. FERRIS.

THIS paper first summarizes the rather extensive and contradictory literature, beginning with E. Büchner in 1897, who claims to have induced active fermentation of various sugars with a sterile extract obtained from dried yeast by filtration through a Berkefeld filter. Büchner's method was followed in the preparation of the yeast. In filtering, the fluid was first passed twice through three thicknesses of filter paper, and then through two thicknesses of parchment paper. The filtered fluid appeared clear and opalescent, but on microscopic examination live cells were found. A filter was then made by putting two thicknesses of filter paper in a glass funnel and coating with about $\frac{1}{2}$ inch of gypsum. The funnel was then fitted into a flask and the whole sterilized. The filtrate from this was clear, but also contained a few live cells. The filtrate remained clear for three days and then became clouded from growth of yeast and bacteria. The same results were obtained from a gypsum filter an inch thick. A porous cup was then used with an aspirator to hasten filtering. Using this filter a sterile extract was obtained. This was tested in 10 and 20 % cane sugar, dextrose and wort solutions, but no fermentation took place in any of them. The experiment was repeated three times and at 37.5°C. as well as at room temperatures, with negative results in every case. The experiments were then repeated with another compressed yeast which also gives vigorous fermentation, but with negative results in every case. Inasmuch as Büchner now states that only certain yeasts possess this property, it is desirable that he should name and describe the yeast or yeasts which he used.

Deterrent Action of Salt in Yeast Fermentation. KATHERINE E. GOLDEN.

THESE experiments show that sodium chloride in any but minute quantities retards fermentation and indicate that where a sponge is used, and a quick fermentation desired, the salt should be added in the last stages. Experiments were made on sponges and stiff doughs at three temperatures, 23°, 37° and 40°C. The following table shows the increments of fermentation in inches, by half hours, in long test-tubes, the temperature being negligible:

No. of Exper.	Per cent. of salt added.	Increments of fermentation in inches.			
		½ hour.	1 hour.	1½ hours.	2 hours.
a	0	.666	1.375	1.708	1.583
b	1	.542	1.292	1.625	1.625
c	2	.456	1.200	1.500	1.666
d	3	.354	.958	1.375	1.375
e	4	.313	.875	1.250	1.375
f	5	.146	.292	.438	1.666

Experiments in fermentation tubes, using 25 cc. volumes of Pasteur's solution with cane sugar, and equal quantities of yeast (1 gram of dry yeast cake) and varying quantities of salt, gave the following results: In the control tube the fluid was driven from the closed end in 23 hours; with 4% salt the fluid was driven out in 37 hours; with 8% salt, in 38 hours; with 12% salt, in 47 hours; with 16% salt, in 7 days.

Leaves of Red Astrachan Apple immune from the Attack of Gymnosporangium Macropus. PROFESSOR W. J. BEAL.

RECORDS failure of disease to spread from

infested cedar trees to two young Astrachan apple trees, purposely planted near, and also negative result of several inoculation experiments, all made in 1897. In 1898 experiments were repeated with same result. States that Professor L. R. Jones, of Vermont, has had the same experiance.

Notes on Stewart's Sweet Corn Germ, Pseudomonas Stewarti n. sp. DR. ERWIN F. SMITH.

ABSTRACT omitted on account of its length. See Proceedings of the Association; also a reprint from the same.

A Bacteriological Study of Pear Blight. LILLIAN SNYDER.

THE greater part of this paper describes a non-parasitic organism which was found associated with *Bacillus amylovorus* in blighting trees. This organism is white and on solid media its colonies closely resemble those of pear blight. It also resembles the latter morphologically. Both germs grew slowly in cornstarch cooked in water, and sugar was not formed. Both change cellulose to sugar and the non-parasitic one gives a slow fermentation when the cellulose is made up with peptone. In pure moistened cellulose the growth of both was very slow and sugar was not formed in either case. Both prefer high temperatures. It differs from the pear blight germ in the following ways: Feeble growth in healthy tissues and no symptoms of blight (young twigs and unripe fruits of the pear and quince). In unripe fruits it was alive at the end of ten days and in some cases had extended to the opposite side of the fruit and into the seeds. Mixed in water in equal parts with the pear blight germ and inoculated into twigs, blight ensued, but when the tissues were examined, at the end of ten days, only *B. amylovorus* was found, although several attempts were made to isolate the other germ.

Unlike pear blight, it ferments potato broth, pear broth and cane-sugar solution, with a copious evolution of gas. A large fermentation tube of Smith's solution yielded about 200 cc. of gas in 10 days. This consisted of 6.2% nitrogen, 61% carbon dioxide and 32.8% hydrogen. The growth in broth made by cooking unripe pears in water was slower than that of *B. amylovorus* and in 48 hours the fluid became a deep green. In peach broth made in the same way the same deep green color appeared and zoogloeæ were quite abundant. The writer has not been able to discover zoogloeæ in cultures of the true blight bacillus. In potato broth this germ grew much more rapidly than *B. amylovorus* and gas production began in a few hours.

This organism is best obtained by placing pieces of tissue in bouillon. The same or a similar germ was also obtained by washing the surface of healthy twigs into bouillon or Smith's solution. One which turned pear broth green was also obtained from the surface of grains, especially wheat. By means of platinum needle transfers from the interior of freshly blighted twigs the true bacillus of the blight may be separated with less danger of contamination. The fact that this germ does not apparently injure the trees when inoculated into them, also that it is obtained by washing the surface of healthy twigs, proves that it has no essential connection with the disease, and renders it probable that it is a surface germ. This work was carried on in the laboratory of Dr. J. C. Arthur, at Purdue University.

Life History and Characteristics of the Pear-Blight Bacillus. MERTON B. WAITE.

BEGINNING in the spring, the germs on the new growth first appear on the nectar disks of the blossoms. The bacilli live and multiply in the nectar and are able to enter the nectar glands without a puncture or injury, and thus normally get inside their host. The distribution from flower to flower and

tree to tree is through the agency of insects, mainly flower-visiting sorts. Infection also occurs on the young shoots, and less frequently on the fleshy bark through injuries. Insects and birds are agents of distribution and inoculation in these cases. No evidence has been found that the germs are carried by the wind. The organism usually dies out in the twigs which are blighted and dead, but in certain cases the germs manage to keep alive during the summer by making slow progress in the fleshy living bark. Such cases may succeed in living over winter. Winter weather is favorable to the longevity of the organism, on account of the moisture and low temperature. These cases of 'hold over blight' start off again in spring and exude quantities of gummy matter full of the bacilli. This is visited by insects, especially flies and wasps, and is carried onto the newly opened flowers, thus completing the cycle of the year. In brief, the characters of the germ are as follows: An oval, rod-like bacillus, 0.6 to 0.8 by 1 to 6 μ, constant in diameter, but varying greatly in length. Occurs singly, or in young cultures in pairs, chains or masses. Stains readily with the ordinary aniline dyes, either in water or alcoholic solution. Has no capsule, but is supplied with several flagella scattered over the surface and is actively motile. Does not produce spores. On nutrient beef and potato broth produces first a strong turbidity and a slight granular pellicle, which breaks up and settles to the bottom. The color of the mass is milky white on all solid media. On agar plates the surface colonies at ordinary temperatures (18° to 20° C.) reach a diameter of about 1 mm. in 48 hours and at the end of a week become 5 to 6 mm. across. A temperature of 36° to 37° C. starts the growth more promptly, but results in a feebler ultimate development. The addition of malic or citric acid in small amounts so as to feebly acidify the agar increases the vigor of growth, while an excess of alkali diminishes it. On gelatine made from the common brands the opposite effect is produced. Gelatine should be neutral to phenolphthalein to insure vigorous development. There is a moderate liquefaction in good gelatine cultures. A moderate growth is made on sterile cooked potato cylinders. In the fermentation tube it decomposes sugar without the formation of gas. It is most vigorous with maltose, the cultures becoming strongly acid, and is slightly less so with cane sugar, dextrose and laevulose. It is aerobic and facultative anaerobic. It produces no pigment or coloring matter of any sort, and no odor. It does not decompose starch. Its principal food consists of nitrogenous matter, sugars and probably to some extent certain organic acids—to wit, the substances found in young growing tissues of its host. Certain statements formerly made are known to be erroneous. The germ mass was said to be yellowish-white on potato. This could only come from an impure culture, as the true pear-blight germ is always white. Gas, or in some places carbon dioxide gas, is said to be formed. This never occurs. Butyric acid is said to be one of the products of its decomposition. The germ produces acids, but never butyric. Starch is said to be decomposed and used as food, but, so far, the author has not been able to demonstrate this. The germ is said to live over winter in the soil. The author has failed to find it in the earth, and its life cycle is complete without such hypothesis.

On the Occurrence of a Yeast Form in the Life Cycle of Sphæropsis malorum. PROFESSOR WM. B. ALWOOD.

PAPER records the discovery of a yeast form in laboratory cultures of this fungus. On isolation and inoculation on the fruit of the apple the common fruit bodies characteristic of *S. malorum* made their appearance.

Some Steps in the Life History of Asters. PROFESSOR EDWARD S. BURGESS.

THIS paper presents results of field-studies of Aster variations made during the last twelve years. Its purpose is to review certain known terms in the ontogeny of Asters which are liable to misinterpretation. These sources of confusion are of three classes, the first of which is the number of leaf-forms normally developed at once upon a single stem. There are eight principal forms:

a. Primordial leaf, usually roundish and transient.

b. Radical leaves, two or three or more, often progressively different.

c. Lower cauline leaves, usually the most characteristic.

d. Middle cauline leaves, usually transitional in shape.

e. Upper cauline leaves, usually much smaller.

f. Axile leaves, subtending the primary axils.

g. Rameal leaves, on primary branches.

h. Bractlets, on the ultimate branches.

According as one or the other of the parts of this leaf-series is more strongly developed, or is suppressed, the plant will change aspect and may be mistaken for a new species. The other two sources of confusion now to be considered are the normal and the accidental, or less usual successive terms in the life-history of the species. These are here treated together, distinguished by number and letter, the normal or usual by the letter *N*, the accidental or less usual by the letter *A*.

N^1 Seedling stage, usually with two small radical leaves.

N^2 Radical-tuft stage, often conspicuous, often remaining some years before developing into N^3.

A^1 Oval-topped stage, frequent in Biotian Asters, the normal cordate radical tuft becoming topped out with the smaller, thinner, oval or other non-cordate leaves.

A^2 Plantain-leaf stage, an occasional extreme development from the last, the non-cordate leaves becoming the predominant ones, and often resembling *Plantago major* in size and shape.

N^3 Cauline stage, normally following N^2, the radical tuft sending up an erect leafy stem which bears six of the eight leaf-forms already mentioned. But instead of taking this normal course of development, the plant may enter upon any one of the following seven stages which are enumerated as accidental or less usual.

A^3 Intercalary stage, when one or more little leaves are interpolated into the series with much larger leaves above and below.

A^4 Arrested stage, when the gradually diminishing normal series of cauline leaves meets sudden arrest from which it never recovers, a succession of little leaves now continuing into the inflorescence.

A^5 Sprout form, usually with leaves somewhat different in form and size from the type.

A^6 Ramified or branch-leaf form, when, after suppression of the main stem, one or more branches rise to replace it, with new direction, and the leaves larger and more numerous, but the leaf-form remaining true to the branch-leaf type for that particular species.

A^7 Bifurcation, either in leaf or stem, arising apparently not from accident, but as a sport.

A^8 Opposite leaf state, due to suppression of internodes, especially upon abnormal branches.

A^9 Verticil form, three nodes brought together in inflorescence or rarely in the leafy stem.

N^4 Aestivation, the budding stage; often a very different aspect is taken here from that before or after.

N^5 Flowering stage, beginning with erect terete rays, which are soon tubular by involution, and in anthesis may change

greatly, according as the following progressions become developed or not:

a. Pedicels lengthen, changing sessile buds into long-pedicelled flower-heads, and dense branches into loose clusters.

b. Cymose development may prolong the outer branches so as to overtop the central and original inflorescence.

c. Rays flatten across, becoming flat and rounded.

d. Rays change position from erect to horizontal, and finally recurved, incurved or pendulous.

e. Rays change color with age to white, greenish or brownish.

f. Disks change color early from yellow to red, reddish-brown or brownish.

g. Disks change from flat to dome-shaped.

h. Pappus changes color by yellowing, darkening or reddening.

A^{10} Enfeebled state, after close cutting down; when the new stems rising from the same root-stocks the next year are often shorter, weaker, scantier and paler in inflorescence and less varied in leaf.

N^6 Resting stage, when, instead of the preceding (N^5) or after it, the root-stock develops radical leaves only for a series of years.

N^7 Surculus stage, a lateral offshoot, arising from the preceding root-stock, rising and making ready to enter upon the radical-tuft stage, N^2, and renew the round of the life-history.

Specific distinctions are hardly to be found in the constant absence or presence of any of the less usual stages, but rather in the relation the plant bears to them when they are found, the ease with which they are induced or thrown off, and the shapes assumed when induced. Some species habitually elide one or more terms in the series, some accelerate them, some prolong or accentuate them. An exceptional development does not invalidate a specific character, as its possibility is latent in all.

The Embryology of Taxus. E. J. Durand.

In this paper the development of the female prothallium is traced from one of an initial axial row of about three cells. The nuclei which result from the division of the nucleus of the macrospore arrange themselves in a peripheral layer, and walls are formed between them so that the young prothallium is in the form of a hollow sphere, the center of which gradually becomes solid from the ingrowth of the cells. The archegonia are developed at the distal end of the prothallium. The neck of the archegonium consists of four cells, instead of one, as is usually stated for this plant.

Effect of Fertilizers on the Germination of Seeds. Gilbert H. Hicks.

The tests were made with the seeds of wheat, lettuce, radish and crimson clover. The conclusions reached are as follows:

1. One per cent. strengths of muriate of potash and of sodium nitrate are very detrimental to seeds, whether applied directly or mixed with the soil.

2. Fertilizers composed of phosphoric acid or of lime are much less injurious to germination, and if not used in excess may be harmless.

3. Commercial fertilizers should not be brought into direct contact with germinating seeds.

4. The effect of treating seeds with chemicals before planting is no index to the action of those chemicals when applied as manures to the soil.

5. The chief injury from chemical fertilizers is effected upon the young sprouts after they leave the seed coat and before they emerge from the soil, while the seeds themselves are injured only slightly or not at all.

6. It is highly improbable that potash, phosphoric acid, nitrogen or lime used as fertilizers actually favor germination.

The Pleistocene and Plant Distribution in Iowa. Dr. T. H. Macbride.

THIS paper offers a new explanation for certain peculiarities of distribution characterizing the flora of that prairie State. It appears that certain plants, especially northern species, are not only very rare in Iowa, but are in their distribution limited to very small and far-separated areas. No existing conditions seem to offer any explanation. Recent study of the pleistocene geology of the State brings to light, however, the fact that these isolated stations for Iowa's rarer plants are all of them *driftless* areas, *i. e.*, areas entirely exempt from glacial deposits. So remarkable is the coincidence that we may confidently say that wherever the geologist finds a driftless hill-top there certain plants are sure to occur and *vice versa*. The paper was illustrated by a map.

Observations on some Hybrids between Drosera intermedia and Drosera filiformis. PROFESSOR JOHN M. MACFARLANE.

THE author reported the discovery and described the appearance of a number of Droseras which are morphologically intermediate between the species named, in number and position of the flowers, number and shape of the leaves, scales, etc., so that he thinks there can be no reasonable doubt as to the occurrence of hybrids between these two species. Drawings were exhibited and explained.

On the Validity of the Genera Senna and Chamæcrista. CHARLES L. POLLARD.

A RECORD of further observations on the structure of the flower of *Cassia Chamæcrista*, on the floral arrangement of which Professor E. L. Greene commented in a recent issue of *Pittonia*. He found that the corolla exhibits a torsion of 90° to the left and thereby differs materially from that of *Cassia* proper. Other characters were adduced to prove the distinctness of the two genera.

Species Characters among the Violets. CHARLES L. POLLARD.

Development of the Pollen Grain in Symplocarpus and Peltandra. B. M. DUGGAR.

DIVISION of the primitive archesporium is of the vegetative type, and the number of chromosomes present is that of the whole number of the sporophyte. The resting nucleus of the definitive archesporium has a large nucleolus taking the chromatin stain in the Flemming combination. The reticulum is a loose net very slightly chromatic. In the cytoplasm there is no differentiated zone of kinoplasm. The contracted state of the chromatin thread in the late reticulum or early spirem was found abundantly at a definite period in the life-history of these cells prior to actual division. In this condition staining is difficult, and the return from this phase is characterized especially by a loosening of the ribbon in one perfect coil, thus truly imitating the spirem. The spirem ribbon becomes nodulate, and finally segmentation is preceded by a bending back of the ribbon at definite points and the disappearance of the chromatin along the connecting linin. The formation of the spindle is multipolar and the chromosomes are centrally as well as peripherally arranged. The nucleolus is peculiar in assuming various shapes and in showing linin connections with the general ribbon. The first division, in general, indicates that there is a longitudinal division of the chromosomes, although in Symplocarpus there is a suggestion that the first division may be the reducing division and hence transverse. In the second division the daughter segments separate longitudinally in both cases. There is no return of the nucleolus prior to the second division, but a true dispirem is formed. This is in accord with studies on Liliaceæ, but differs from what is found in some dicotyledonous plants. In the division of the microspore nucleus the nucleus migrates to one side of the cell and the entering kinoplasm forms a multipolar somewhat barrel-shaped spindle. This finally

becomes completely attached at one pole, forming a truncated cone, while the other pole of the spindle may be truly conical. This fixity of the spindle causes the unequal division of the cell body, necessitating the small generative cell. This method of division (fixity of one pole) seems to be characteristic of such divisions in many plants.

Notes on the Embryo-sacs of Certain Monocotyledons. K. M. WIEGAND.

RECENT investigations by Dr. Wiegand tend to show that the two extreme types of embryo-sac formations as illustrated by *Lilium* and *Canna* are related in a manner not before observed. In *Convallaria*, which represents the transitional type, a septum is formed after the first division of the hypodermal nucleus, but not after the second. This represents an axial row of four cells with two septa omitted. The remaining septum at length breaks down, so that a single cavity containing eight nuclei results. The single cell of *Lilium* is, therefore, derived from the four axial cells of *Canna*, not primarily through the omission of any divisions of the mother cell, but by the absence of the septa.

Studies Relative to the Perigynium of the Genus Carex. K. M. WIEGAND.

THREE theories have been advanced as to the homology of the perigynium in the genus *Carex*. By Bentham and others it was considered to be composed of two united bracts. Schleiden considered it to be a modified perianth ; but the most plausible theory is that advanced by Pax, Dyer and Kunth, who emphasize the fact of its close resemblance to the prophyllum of other monocotyledons. In many cases the secondary axis within the perigynium develops to such an extent that several rudimentary flowers are formed in addition to the fertile one. The perigynium is, therefore, not a perianth. The position of the odd carpel, which is turned toward the main axis of the spike, and the development of the perigynium from two posterior teeth, seem to indicate that the perigynium is, indeed, a modified prophyllum.

Rapidity of Circumnutation Movements in Relation to Temperature. E. SIMONS and R. E. B. MCKENNEY.

FIVE species were experimented with, viz.: *Phaseolus vulgaris, Humulus lupulus, Convolvulus sepium, Lonicera brachypoda* and *Wistara sinensis.* Darwin also experimented on these plants, but gives few exact details as to temperature. The average there in England is 15° or 16° C. in spring and 20° to 23° C. in summer. In this paper no account is taken of the relative intensity of the light, although data are being gathered which prove that this is an extremely important factor. In dull cold days, with temperature at 15° to 19° C. movements were found to be *extremely* slow. The average optimum for best results was 28° C. In *Convolvulus sepium* two distinct types of stem were observed, a rapidly circumnutating and a prostrate one showing extremely feeble movements. In the results obtained by the writers it is safe to assume that the temperature was on the average 12° C. higher than that worked in by Darwin, and in most cases the periods of revolution are very considerably shorter, but at present it would be rash to say that the higher temperature is the sole or even the main determining factor in the more rapid movement. Light intensity and hygrometric conditions of the atmosphere have been found to cooperate also, but present indications are that temperature is a very important factor, and that an optimum as well as a maximum and minimum temperature exist for each species.

General Characteristics of the Duneflora of Southeastern Virginia. THOMAS H. KEARNEY, JR.

REPORT of a preliminary survey of the

plants of the coastal plain with reference to their ecological distribution. The soils, heat, light and other physical conditions were first described. The principal plant groups were thus described with an enumeration of some of the more evident adaptations by which the plants were brought into harmony with the physical conditions.

Vegetation of the Wooded Fresh-water Swamps of Southeastern Virginia. THOMAS H. KEARNEY, JR. (Read by title.)

Notes on Arctic Willows. PROFESSOR W. W. ROWLEE.

THE Cornell party on the Peary expedition of 1896 brought back an exceptionally good collection of willows on which this paper is based. The glaucoid and myrtilloid groups, which are perhaps the most difficult to segregate, have several interesting forms. This paper attempts to characterize the forms of *Salix glauca* L. and *S. grœnlandica.*

A Self-registering Transpiration Machine. EDWIN B. COPELAND.

DESCRIPTION of a very simple and easily operated apparatus, consisting of a wheel over which runs a string carrying the plant tested on one end and an areometer on the other. As the plant loses weight, the counter weight, the areometer sinks. The record is kept as with an auxanometer. One day's record was presented to illustrate the working of the machine. To be published in *The Botanical Gazette.*

Methods of Studying the Sap Pressure of the Sugar Maple. PROFESSOR L. R. JONES.

AFTER some unsatisfactory experiments with the common mercurial gauge, a self-recording steam-pressure gauge (which was exhibited) was substituted with very good results. Lithium passed upward and downward in the maples very rapidly, but there was very little sidewise movement of this substance.

Notes on the Physiology of the Sporophyte of Funaria and Mnium. DR. RODNEY H. TRUE.

THE growth rate of the sporophyte of these mosses may be represented by a rather flat curve rising somewhat more gradually than it falls. Subsequent to the breaking loose of the calyptra from the gametophyte, growth is confined to the distal end of the sporophyte, and the growing region, about 2 mm. long, is entirely enclosed by the calyptra.

The calyptra, much developed in *Funaria*, less so in *Mnium*, is a protective structure chiefly useful in preventing desiccation. In *Funaria* the cells of the calyptra are living and contain chlorophyll grains. They are probably self-supporting as regards nutrition until the rupture of the calyptra.

The curvature of the seta in this species results as a response to the stimulus of gravitation. In the earlier stages of its growth the seta is not sensible to this stimulus, but becomes so as the time for the development of the capsule approaches, and by use of the mechanism of growth executes the curvature.

The direction of the strongest illumination determines the radius in which the capsule shall fall. In *Mnium* the capsule falls with great regularity away from the direction of the strongest illumination, thus exposing the end of the capsule bearing the stomata to the light. Occasionally some fall directly toward the strongest light, but very rarely out of that plane.

Funaria obeys, with much less precision and regularity, the same rule. The conduct of these mosses varies in accordance with the nature of the situations which they are wont to occupy.

The Seeds and Seedlings of some Amentiferæ. W. W. ROWLEE and GEO. T. HASTINGS.

As compared with the other groups of angiosperms the Amentiferæ have been, so

far as their seeds and seedlings are concerned, very indifferently observed. Finding this to be true led the authors of this paper to grow seedlings of the native representatives of the group. Their studies have led to the following conclusions: 1. The cotyledons in *Juglans* and *Hicoria* correspond with the valves of the nut, and are deeply two lobed. The two divisions of the embryo resembling cotyledons are each made up of halves of the cotyledons. 2. The seeds of *Hicoria* germinate without frost action; those of *Juglans* only with frost action. 3. The tap-root is very thick in young seedlings, and very long in in older ones. 4. In *Castanea* and *Quercus* the shell is split by a swelling of the cotyledons in germination. 5. In the species of *Quercus* studied, the leaves of the seedlings were much alike, and not deeply cut or lobed. 6. *Fagus* is the only genus in which the hypocotyl lengthens, or the cotyledons become aerial.

The paper was illustrated by two plates; one showing the peculiar division of the cotyledons in *Juglans* and *Hicoria*, the other various seedlings of the group.

The Morphology and Taxonomic Value of the Fruits of Grasses. P. BEVERIDGE KENNEDY.

THE presence of an epiblast and a plumule sheath distinguishes the embryo of the Gramineæ from that of other monocotyledons. About eighty genera were investigated to determine the constancy, morphological significance and taxonomic value of these peculiar organs. In general, species of the tribes Maydeæ, Andropogoneæ, Zoysieæ and Tristeginæ are without epiblasts, while those of the tribes Oryzeæ, Agrostideæ, Aveneæ, Chlorideæ, Phalarideæ, Festuceæ, and perhaps the Bambuseæ possess epiblasts. Peculiar exceptions occur in some tribes, *e. g.*, the Hordeæ appears to have equally as many with as without epiblasts. From study of the perfectly developed epiblasts in *Zizania*, *Leersia* and *Oryza* the author is led to believe that the epiblast is a second rudimentary cotyledon opposite to the scutellum (cotyledon). The plumule sheath is constant in all embryos, and from his study of the vascular system, together with Hanstein's investigations on the development of the embryo of Brachypodium, the author believes that it is a ligule-like growth belonging to the scutellum and is homologous with the ligule of the fully developed grass leaf. Unlike Bentham and Haeckel, he is inclined to believe that the Bambuseæ and Oryzeæ together represent the most primitive grasses. The Oryzeæ resemble the Bambuseæ as follows: 1. They show great variation in the structure of their fruit and spikelet. 2. They possess remarkably large epiblasts. 3. Some have the same number of lodicules. 4. *Pharus* has a style with three stigmas. 5. Many of the genera have broad petiolate leaves and transitions between these into linear leaves. 6. To a great extent they have the same geographical distribution, the larger number of the genera being indigenous to tropical America. According to Haeckel's classification, the tribes Zoysieæ, Tristeginæ, Andropogoneæ, Maydeæ and Paniceæ, both according to the characters of the fruit and those of the inflorescence, form another natural group joined to the Oryzeæ through Zoysieæ and Tristegineæ. The Chlorideæ, although regarded by Haeckel and Warming as being removed some distance from the Andropogoneæ, have been found like them in their fruit characters. Judging from their fruit characters, the remaining tribes, Phalarideæ Agrostideæ, Aveneæ, Festuceæ and Hordeæ form another natural group in the order named, and this coincides with the classification given by Haeckel.

To avoid a session Thursday evening, the following papers were read by title:

The Caryopsis of the Gramineæ. PROFESSOR L. H. PAMMEL.

The Ecological Distribution of Colorado and Wyoming Plants. PROFESSOR L. H. PAMMEL.

Fertilization of the Muskmelon Flower. PROFESSOR WM. F. RANE.

Notes on Destroying Comptonia asplenifolia. PROFESSOR WM. F. RANE.

Length of Time from Blossoming to Seed Development in Leucanthemum vulgare. PROFESSOR WM. F. RANE.

The Work Performed by the Agricultural College toward a Botanical Survey of Michigan. PROFESSOR W. J. BEAL.

SEVEN additional titles appeared on the preliminary program, but were omitted from the regular program because no abstracts were furnished.

ERWIN F. SMITH,
Secretary.

WASHINGTON, D. C.